DIRECT TESTIMONY AND EXHIBIT OF

PHILIP HAYET

ON BEHALF OF

THE SOUTH CAROLINA OFFICE OF REGULATORY STAFF

DOCKET NO. 2019-226-E

IN RE: SOUTH CAROLINA ENERGY FREEDOM ACT (HOUSE BILL 3659)

PROCEEDING RELATED TO S.C. CODE ANN. SECTION 58-37-40 AND

INTEGRATED RESOURCE PLANS FOR DOMINION ENERGY SOUTH

CAROLINA, INCORPORATED

Q. STATE YOUR NAME, BUSINESS ADDRESS AND OCCUPATION.

A. My name is Philip Hayet and I am a Vice President and Principal of J. Kennedy and Associates, Inc. ("Kennedy and Associates"). My business address is 570 Colonial Park Drive, Suite 305, Roswell, Georgia, 30075.

Q. DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I received a Bachelor of Science degree in Electrical Engineering from Purdue University, and a Master of Science degree from the Georgia Institute of Technology, with a specialization in Power Systems Analysis. I have over forty (40) years of experience in the electric utility industry, having worked in the areas of resource planning, economic analysis, generation operations, rate analysis, and utility policy analysis. I was employed from 1979 to 1996 by Energy Management Associates ("EMA", now known as ABB Enterprise Software, Inc.), and I supported that vendor's PROMOD IV™ ("PROMOD")

and STRATEGIST clients.[1] In 1996, I formed Hayet Power Systems Consulting ("HPSC") where I offered consulting services to clients in the United States and internationally. In 2000, I continued to work for HPSC, but I also joined the Kennedy and Associates' firm. In 2015, HPSC and Kennedy and Associates merged, and I became a Principal of Kennedy and Associates. I have testified as an expert witness in numerous cases in states across the United States, including Georgia, Indiana, Kentucky, Louisiana, Minnesota, Utah, Wisconsin, Wyoming, and at the Federal Energy Regulatory Commission ("FERC"). A summary of my education, experience, and expert testimony appearances is included in Exhibit PH-1.

Q. ON WHOSE BEHALF DO YOU PROVIDE THIS TESTIMONY?

A. I am providing this testimony on behalf of the South Carolina Office of Regulatory Staff ("ORS").

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION")?

A. I have not previously testified before the Commission. However, I have testified in numerous cases before 8 state regulatory commissions and the FERC on similar issues as I am addressing in this case.

Q. DESCRIBE THE PURPOSE OF YOUR TESTIMONY.

A. The purpose of my testimony is to describe Kennedy and Associates' review of the Dominion Energy South Carolina, Inc.'s ("DESC" or "Company") 2020 Integrated Resource Plan ("DESC IRP"), including the assessment of the Company's compliance with

[1] PROMOD is a detailed hourly probabilistic production cost model, and STRATEGIST is a long-term resource optimization planning model.

the statutory requirements of S.C. Code Ann. Section 58-37-40 ("Section 40"), as amended by the South Carolina Energy Freedom Act ("Act 62").

I worked closely with the ORS team, including Anthony Sandonato and others, and my colleagues, Mr. Stephen J. Baron, Mr. Lane Kollen, and other consultants at Kennedy and Associates. We prepared a report entitled, "Review of Dominion Energy South Carolina, Inc. 2020 Integrated Resource Plan" (the "Report"), which includes our findings, conclusions, and recommendations. A copy of the Report is attached to ORS witness Anthony Sandonato's direct testimony as his Exhibit AMS-1.

Mr. Kollen and Mr. Baron also filed direct testimonies in this proceeding and discuss their responsibilities and analysis associated with the Report in their respective direct testimonies.

Q. DESCRIBE THE SCOPE OF KENNEDY AND ASSOCIATES' REVIEW OF DESC'S IRP.

A. Kennedy and Associates performed a comprehensive review of the Company's planning process and IRP filing, and evaluated whether DESC complied with the requirements of Section 40. As part of the review, Kennedy and Associates investigated the historical context of the IRP process in South Carolina, including the Act 62 requirements, prior Company IRP filings, and Commission precedents. Kennedy and Associates then reviewed all of the significant features of DESC's IRP, including the load and energy forecasting process, reserve margin policy, demand side management ("DSM") assumptions, natural gas and CO_2 price forecasting methodologies, existing supply side resources, development of generic new supply side resources, alternative resource plans that reflect the timing, type, size, and cost of new resource additions and retirements of

existing resources, production cost modeling, capital revenue requirement analysis, economic analyses and ranking of expansion plan results, transmission system planning process and potential investments, and plans for distribution and integrated system planning. Based on our review, we assessed whether the Company complied with the statutory requirements of Section 40, including the Act 62 amendments.

Q. PLEASE PROVIDE A BRIEF SUMMARY OF THE CONCLUSIONS THAT KENNEDY AND ASSOCIATES REACHED.

A. Based on our review, we concluded that the Company's IRP provides flexibility and a range of plausible paths that the Company could pursue; however, we also found that the DESC IRP analyses contained a significant number of flaws related to its assumptions and modeling methodologies. For example, there were errors in transferring PROSYM results to the economic analysis spreadsheet, missing fixed transportation costs and financing costs, issues with probable retirement dates and operating life assumptions, and improper assumptions associated with modeling battery energy storage system ("BESS") resources. Because of the issues we identified, we were unable to reach the same conclusion as stated by Company witness Bell in his direct testimony, which is that "…resource plan 2 is the low-cost alternative for customers and therefore is the preferred plan."[2]

Aside from the errors in assumptions and modeling methodologies, another reason we were unable to reach the same conclusion regarding RP2 is that in a subsequent analysis performed to consider whether to repair or retire the Wateree 2 unit, the Company

[2] See Direct Testimony of Eric Bell, pg. 25, at ln. 21.

identified a lower cost resource plan ("RP") than RP2.[3] In light of this new information, the Company should evaluate further whether the new plan from the Wateree 2 analysis should be considered the Company's least cost preferred IRP plan.

Q. PLEASE CHARACTERIZE THE RECOMMENDATIONS THAT KENNEDY AND ASSOCIATES IDENTIFIED IN THE REPORT.

A. The recommendations relate to the Company's load and energy forecasts, generic resource profiles, production cost and revenue requirements modeling, and assumptions relied on to develop the RPs and the resulting comparison metrics. Many recommendations address concerns and errors that should be addressed in the form of a modified IRP in this proceeding. Other recommendations address concerns that should be addressed in the next annual update to the IRP, but no later than the next comprehensive IRP in 2023. These recommendations are no less important but recognize that the implementation and use of new modeling tools and methodologies will require additional time and cannot reasonably be accomplished in this proceeding.[4]

Q. COULD YOU PROVIDE A LIST OF SPECIFIC RECOMMENDATIONS THAT YOU IDENTIFIED IN THE REPORT THAT SHOULD BE ADDRESSED IN THE FORM OF A MODIFIED IRP IN THIS PROCEEDING.

A. Yes, the items are included in the following table. The numbers correspond to the same items that are found in the list in the Executive Summary section of the Report. There

[3] In ORS AIR 6-4, the Company elaborated on the Wateree 2 forced outage that occurred on February 19, 2020. As a result of that forced outage, the Company conducted a repair/replace/retirement study, which resulted in a decision to replace the Wateree 2 generator stator mid-section and to rewind the existing generator field. It based that decision on a different long-term resource plan than RP2, which included a CC unit in 2035 instead of an ICT unit in that year.

[4] For example, the Company is investigating new models for future IRPs, including a resource optimization model, which ORS considers to be a high priority item. Preferably, the new model should be implemented and used to develop the RPs in the next two (2) annual IRPs, but certainly should be used to develop the RPs in the next comprehensive IRP in 2023.

the items are listed sequentially as they appear in the Report. Here, two lists are provided; the first list contains the items that should be corrected for this IRP, and the second contain the items that should be addressed in the next annual update to the IRP, but no later than the next comprehensive IRP in 2023.

Item	Recommendations for this IRP
11	The Company should update its Wateree 2 analysis by correcting errors and properly accounting for the insurance payout.
12	The Company should include a discussion of the Wateree 2 outage and the decision it makes to either repair or retire the unit.
13	The Company should review its assumptions regarding long-term continuing capital cost de-escalation of renewable energy projects
14	The Company should review its capital cost assumptions for its internal combustion turbine ("ICT") resource in this IRP to ensure that the costs are reasonable given its assumption appears to be much lower that other industry estimates.
15	The Company should include fixed operation and maintenance ("O&M") expenses for new owned solar and BESS resource additions in this and future IRPs.
16	The Company should review its O&M assumptions for all combined cycle ("CC") and ICT resource options and revise those assumptions in this IRP if they are found to be unreasonable or in error.
21	The Company should escalate its cost assumptions for short-term winter capacity purchases.
22	The Company should update its IRP to include tables that rank all RPs under all sensitivities.
23a	The Company should correct errors in the transfer of PROSYM expenses to the Excel revenue requirement models.
23b	The Company should include capitalized interest ("AFUDC") in its revenue requirement modeling.

Item	Recommendations for this IRP
23c	The Company should correct errors in calculations that escalated capital expenditures to future dollars for new resource additions and for Wateree and Williams Effluent Limitation Guidelines ("ELG") capital expenditures/plant additions
23d	The Company should include incremental capital expenditures/plant additions for existing resources and new resources after commercial operation, with the sole exception of the Wateree and Williams ELG capital expenditures/plant additions.
23e	The Company should replace each new BESS resource after its assumed ten year operating life.
23f	The Company should properly account for Investment Tax Credits for new owned solar and BESS resource additions.
23g	The Company should include dismantlement costs, site restoration costs, and incremental transmission costs necessary for post-retirement voltage support for existing resources, particularly resources studied for possible early retirement.
23h	The Company should use the correct depreciable life assumption for ELG capital expenditures/plant additions.
23i	The Company should include ICT natural gas firm transportation costs in any of the RPs.
23j	The company should include the capital revenue requirements of the new ICT resource addition in 2040 in RP8.
23k	The Company should review its escalation calculations for final ten (10) years of the study period as discussed in the Report.

Q. COULD YOU PROVIDE A LIST OF SPECIFIC RECOMMENDATIONS THAT YOU IDENTIFIED IN THE REPORT THAT SHOULD BE ADDRESSED IN THE NEXT ANNUAL UPDATE TO THE IRP, BUT NO LATER THAN THE NEXT COMPREHENSIVE IRP IN 2023.

A. Yes, the items are included in the following table.

Item	Recommendations for a Future IRP
1	The Company should provide a more thorough presentation of its load and energy forecasting methodology in future IRPs.
2	The Company should improve its residential and commercial peak load forecasting methodology to reflect behavioral factors that are likely to impact peak demand over time.
3	The Company should expand the number of sensitivities it analyzes to include both DSM scenarios and actual load growth scenarios in the expansion plan and economic analyses it performs.
4a	The Company should include a detailed analysis of its reserve margin methodology, possibly in an Appendix, including additional explanation of its dual reserve margin criteria.
4b	The Company should also include with its reserve margin information, support for its inclusion of the VACAR Reserve Sharing Agreement operating reserve obligation in its reserve margin calculation.[5]
5a	The Company should consider utilizing an optimal economic based reserve margin methodology.
5b	The Company should present the results of a traditional Loss of Load Expectation analysis, which includes assessing the impacts of varying weather conditions and tie line support.
6	The Company should only use DSM assumptions that it has confidence in and believes are reasonable and achievable.
7	The Company should reexamine its gas forecasting methodology, investigate alternative approaches, and perform a comparison to other publicly available forecasts to evaluate the reasonableness of its forecasts.
8	The Company should address the availability and constraints of natural gas pipeline capacity and supply on the timing, size, and location of potential new CC and ICT resource additions in future IRPs.
9	The Company should include a third CO_2 price sensitivity case in future IRPs.

[5] North American Electric Reliability Corp VACAR subregion, which includes most of Virginia and the Carolinas.

Item	Recommendations for a Future IRP
10	The Company should conduct a detailed retirement study using corrected modeling assumptions and address all potential early retirement candidates.
17	The Company should reevaluate its assumption regarding its reliance on generic winter capacity purchases and ensure that any decision to add those capacity purchases is made based on the availability and economics of the capacity purchases.
18	The Company should incorporate a least cost optimization expansion planning model.
19	The Company should expand the number of RPs evaluated for future IRPs filings.
20	The Company should develop alternative RPs for different gas price and CO_2 sensitivities in future IRP filings.
24	The Company should complete the studies to address the changes to the transmission system and the related investment infrastructure costs necessary for new solar resource additions and include that information and a description of its studies and conclusions in the next comprehensive IRP in 2023.
25	The Company should supply additional information about distribution resource plans and integrated system operational plans.
26	The Company should create a stakeholder process to provide opportunities for stakeholder involvement and input in the formulation of future IRPs.
27	The Company should develop a three-year action plan that identifies all actions the Company intends to take in order to implement its IRP in each future update and comprehensive IRP.

Q. WHAT WERE YOUR PRIMARY RESPONSIBILITIES WITH REGARD TO THE REPORT?

A. I had the primary responsibility for developing the following sections:

- Evolution of the IRP Process in South Carolina
- Demand Side Management

- Natural Gas Price Forecasts
- CO_2 Price Forecasts
- Existing System
- Generic Resource Options
- Transmission System Planning and Investments
- Distribution and Integrated System Operations Plans
- Other Considerations

I also had primary responsibility for reviewing the Company's production cost modeling results, and also the responsibility for reviewing the workpapers used to create the Company's RPs, the Intervenor's RPs, and the Wateree 2 repair/retirement RPs. Mr. Baron and Mr. Kollen describe their responsibilities in their respective direct testimonies.

Q. PLEASE SUMMARIZE THE CONCLUSIONS OF YOUR ANALYSIS.

A. The conclusions I was responsible for begin in the Demand Side Management ("DSM") section of the Report. Regarding the High DSM case, the Company developed its assumptions assuming it would achieve a 1% annual reduction in energy sales. While the Company performed a significant number of analyses based on that case, it essentially disputed the validity of the case by stating, the case was "not supported by any analysis that would establish that a DSM program at that level would be practical and achievable….,"[6] and the Company also stated "…this case in the IRP in no way indicates that DESC believes that it is reasonable or achievable."[7] It is highly unusual for a utility to distance itself from its own IRP assumptions as DESC has. We recommend that in future

[6] Direct Testimony of James Neely, at pg. 12, ln. 1.
[7] Direct Testimony of Eric Bell, at pg. 11, ln. 10.

IRPs, the Company should only use assumptions that it has confidence in and believes are reasonable and achievable.

The Company's natural gas price forecasts appear to be low throughout the study period compared to other recent industry forecasts that we have reviewed (see Figures 5, 6, and 7 in the Report). We pointed out that some assumptions appeared to be arbitrary, and recommended the Company reexamine its methodology, investigate alternative approaches, and perform a comparison for reasonableness purposes of its forecast results to other publicly available forecasts in future IRPs. Another natural gas issue we addressed was that the Company made certain decisions about the timing of when new CC and ICT resources could be added to its System based on the availability of natural gas supply and pipeline constraints, yet that was not discussed in DESC's IRP Report. We recommend that in future IRPs the Company should discuss natural gas supply issues in its IRP.

With regard to CO_2 modeling, the Company only evaluated one CO_2 forecast in its IRP, or two if DESC's \$0/ton CO_2 case is considered a CO_2 forecast. Most of the other IRPs reviewed included at least three CO_2 forecasts (including a \$0/ton CO_2 case), and we recommend that in future IRPs, DESC should include an additional IRP forecast to analyze a wider range of CO_2 prices for improved sensitivity evaluation in its analyses.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS WITH RESPECT TO THE COMPANY'S EXISTING SYSTEM RESOURCES.

A. With regard to the Company's Existing System resources, given the significant number of errors that we identified in the Report related to the Company's PROSYM and capital revenue requirement analyses, we recommend that the Company immediately correct the

modeling errors as identified in the Report, and redo its IRP analyses and provide an update to this IRP.

With regard to retirement considerations, given the outage of the Wateree unit, and the fact that some of the Company's units have a probable retirement date of 2028, it is clear that the Company should conduct a detailed retirement analysis in the near future. The study should be performed with corrections to the modeling errors that were identified in the Report. We recommend that this study should analyze all potential retirement units, and should be conducted prior to the next IRP, but no later than the next comprehensive IRP in 2023.

However, since the Wateree 2 retirement study was found to contain errors, and is a pressing matter, we recommend that the Company immediately redo that study using corrected assumptions, as discussed in the Report. This includes modeling the proper probable retirement dates at the Urquhart and McMeekin gas-fired steam turbine units, as well as the other errors that we discuss in the Report. The Wateree 2 issue is important and must be addressed immediately, and the Company should discuss its decision making process and findings in an updated IRP Report in this proceeding.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS WITH RESPECT TO GENERIC RESOURCES.

A. With regard to generic resource options, we identified several concerns and included a number of recommendations in the report. First, the Company should review its assumptions regarding long-term continuing capital cost de-escalation of renewable energy projects. It is simply unreasonable to assume that solar and BESS resources will continue to de-escalate indefinitely. Taken to the extreme, at some point, these renewable

resources would appear to have virtually no capital cost. This data assumption correction should be performed as an update in this IRP. Second, the Company should review its ICT capital cost assumption for reasonableness. According to the results provided in Table 11 of the Report, the Company's capital cost assumption appears to be low. It would be worthwhile for the Company to review its assumption and discuss its findings in an update to this IRP.

Third, the Company neglected to include fixed O&M for new owned solar and BESS resource additions in its IRP. It is unlikely that the Company would not incur annual fixed O&M expense to operate those units, and it should include an appropriate assumption for fixed O&M in an update to this IRP.

Fourth, the Company should reevaluate its assumption regarding its reliance on generic winter capacity purchases and ensure that any decision to add those capacity purchases is made based on the availability and economics of the capacity purchases. However, this item may be addressed by the Company incorporating an optimal resource expansion planning model in a future IRP. ORS believes that adding such a modeling capability is a high priority item and should be implemented prior to the next IRP, but no later than the next comprehensive IRP in 2023.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS WITH RESPECT TO THE COMPANY'S TRANSMISSION SYSTEM PLANNING AND INVESTMENT.

A. The Company provided a summary description of its transmission planning process and a list of major planned transmission projects in Section III of the IRP report. The Company also noted that the addition of intermittent resources, namely new solar

resources, will require additional study to determine the impacts on the existing transmission system. The additional investment may be significant, and the physical assets will need to be in operation to add significant new solar resources, if that ultimately becomes part of the Company's resource plan. ORS recommends that the Company complete the studies regarding the changes that will be necessary to the transmission system to add new solar resources, including the additional investment infrastructure costs, prior to its next comprehensive IRP in 2023 and include that information and a description of its studies and conclusions in that filing.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS WITH RESPECT TO THE COMPANY'S DISTRIBUTION RESOURCE PLANS OR INTEGRATED SYSTEM OPERATIONS PLANS.

A. Section 40(B)(2) contains the provision that "An integrated resource plan may include distribution resource plans or integrated system operations plans." The Company discusses issues related to distribution resource plans throughout the IRP including discussions of DSM, Advanced Metering Infrastructure, and the Company notes that in order to increase levels of renewables it will need to perform studies and conduct research. ORS agrees with the Company's desire to perform additional studies and conduct research to properly assess the impacts of more renewable resources, as well as to plan for other emerging solutions and resources that are rapidly advancing in the industry. ORS recommends the Company provide more detailed plans concerning this in future IRPs, including any plans to conduct a more integrated optimal generation, transmission, and distribution planning approach.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS OF THE OTHER CONSIDERATIONS YOU IDENTIFIED.

A. Two items were identified related to this topic. First, we noted that it has been an increasing trend in the industry to incorporate more stakeholder involvement in utilities' IRP processes. Based in part on our review of other utility stakeholder processes, we recommended that the Company implement such a process in future IRPs, but we also cautioned that the Company should take care to ensure the process does not become overly burdensome.

Second, though the statutory requirements of Section 40 do not mandate that a utility include a Short Term Action Plan in its IRP Report, it is typical that most utility IRP Reports do include such a plan. We recommend that in future IRPs, the Company should develop a 3-year action plan that identifies all actions the Company intends to take in order to implement its IRP.

Q. PLEASE PROVIDE A SUMMARY OF THE CONCLUSIONS AND THE OVERALL RECOMMENDATIONS REACHED FROM YOUR ANALYSIS.

A. ORS recommends the Company be required to modify the IRP to address the problems requiring immediate attention as identified in the Report. This includes correcting the errors in the eight (8) RPs, the sensitivity cases, and the Intervenor cases presented in the IRP. The Company should correct and present revised versions of the Wateree 2 analyses. The Company should also present its results and findings, and it should identify a revised RP as the least cost preferred RP. In addition, ORS recommends the Company be required to improve its IRP planning process, including the modeling tools and methodologies used to develop the IRP in future IRPs.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

EDUCATION/CERTIFICATION

M.S., Electrical Engineering, Georgia Institute of Technology, 1980
B.S., Electrical Engineering, Purdue University, 1979
Cooperative Education Certificate, Purdue University, 1979

PROFESSIONAL AFFILIATIONS

National Society of Professional Engineers
Georgia Society of Professional Engineers
Institute of Electrical and Electronic Engineers

EXPERIENCE

After completing his Master's degree, Mr. Hayet worked for fifteen years at Energy Management Associates, now Ventyx, providing consulting services and client service support to electric utility companies for the widely used planning models, PROMOD IV and STRATEGIST. Mr. Hayet had an instrumental role in designing some of the modeling features of those tools including the competitive market modeling logic in STRATEGIST.

In 1996, Mr. Hayet formed the utility consulting firm, Hayet Power Systems Consulting ("HPSC"), and worked for clients in the United States, and internationally in Australia, Japan, Singapore, Malaysia, the United Kingdom, and Vietnam. Mr. Hayet's expertise covers a number of areas including utility system planning and operations, RTO analysis, market price forecasting, Integrated Resource Planning, renewable resource evaluation, transmission planning, demand-side analysis, and economic analysis.

In 2000, Mr. Hayet also joined the consulting firm of J. Kennedy & Associates, Inc. ("Kennedy and Associates") and assisted on projects that required utility resource planning, analysis, and software modeling expertise. Mr. Hayet merged his firm and became a Vice-President and Principal of Kennedy and Associates in 2015. Mr. Hayet has provided consulting services to Public Utility Commissions, Regional Power Pools, State Energy Offices, Consumer Advocate Offices, Global Power Developers, and Industrial Companies.

Mr. Hayet has conducted numerous consulting studies in the areas of RTO Cost/Benefit Analysis, Renewable Resource Evaluation, Renewable Portfolio Standards Evaluation, Electric Market Price Forecasting, Generating Unit Cost/Benefit Analysis, Integrated Resource Planning, Demand-Side Management, Load Forecasting, Rate Case Analysis and Regulatory Support.

2000 to Present: **J. Kennedy and Associates, Inc.**
Vice President and Principal

- Initially began as Director of Consulting, became Vice President and Principal in 2015
- Managed electric related consulting projects.
- Responsible for business development.
- Clients include Staffs of Public Utility Commissions and other State Agencies, State Energy Offices, Global Power Developers, and Industrial Groups, and large energy users.

1996 to Present: Hayet Power Systems Consulting
President and Principal

- Managed electric utility related consulting projects
- Clients include Staffs of Public Utility Commissions and other State Agencies, State Energy Offices, Global Power Developers, and Industrial Groups, and large energy users.

1991 to 1996: EDS Utilities Division, Atlanta, GA (Now Ventyx)
Lead Consultant, STRATEGIST Department

- Managed a client services software team that supported approximately 75 users of the STRATEGIST electric utility strategic planning software.
- Participated in the development of STRATEGIST's competitive market modeling features and the Network Economy Interchange Module
- Provided client management direction and support and developed new consulting business opportunities.
- Performed system planning consulting studies including integrated resource planning, DSM analysis, marketing profitability studies, optimal reserve margin analyses, etc.
- Based on experience with PROMOD IV, converted numerous PROMOD IV databases to STRATEGIST, and performed benchmark analyses of the two models.

1988 to 1991: Energy Management Associates (EMA), Atlanta, GA
Manager, Production Analysis Department

- Served as Project Manager of a database modeling effort to create an integrated utility operations and generation planning database. Database items were automatically fed into PROMOD IV.
- Supervised and directed a staff of five software developers working with a 4GL database programming language.
- Interfaced with clients to determine system software specifications, and provide ongoing client training and support

1980 to 1988: **Energy Management Associates (EMA), Atlanta, GA**
Senior Consultant, PROMOD IV Department

- Provided client service support to EMA's base of over 70 electric utility customers using the PROMOD IV probabilistic production cost simulation software.
- Provided consulting services in a number of areas including generation resource planning, regulatory support, and benchmarking.

TESTIMONY AND EXPERT WITNESS APPEARANCES

Date	Case	Jurisdict	Party	Utility	Subject
09/98	97-035-01	UT	Utah Committee for Consumer Services	PacifiCorp	Utah jurisdictional Net Power Costs, PacifiCorp Rate Case Proceeding
07/01	01-035-01	UT	Utah Committee for Consumer Services	PacifiCorp	Utah Jurisdictional Net Power costs in General Rate Case
2001	ER00-2854-000	FERC	Louisiana Public Service Commission	Entergy	Proposed System Agreement Modifications
07/02	02-035-002	UT	Utah Committee for Consumer Services	PacifiCorp	Special contract for industrial consumer
2002/ 2003	U-25888	LA	Louisiana Public Service Commission	Entergy	Investigation of retail issues related to the System Agreement
2003	U-27136 Subdocket A	LA	Louisiana Public Service Commission Staff	Entergy	Aging gas steam-fired retirement study
07/03	EL01-88-000	FERC	Louisiana Public Service Commission	Entergy	Rough production cost equalization proceeding
05/04	03-035-14	UT	Utah Committee for Consumer Services	PacifiCorp	Development of a large QF avoided cost methodology
06/04	18687-U 18688-U	GA	Georgia Public Service Commission Staff	Georgia Power and Savannah Electric	2004 Integrated Resource Planning Studies
08/04	ER03-583-000	FERC	Louisiana Public Service Commission	Entergy	Affiliate power purchase agreements
11/04	03-035-19	UT	Utah Committee for Consumer Services	PacifiCorp	Industrial customer's request for a special economic development tariff
11/04	03-035-38	UT	Utah Committee for Consumer Services	PacifiCorp	Large QF proceeding.
03/05	03-035-14	UT	Utah Committee for Consumer	PacifiCorp	Concerning PacifiCorp's Schedule 38 avoided cost tariff and remaining

Date	Case	Jurisdict	Party	Utility	Subject
			Services		unsubscribed capacity
07/05	03-035-14	UT	Utah Committee for Consumer Services	PacifiCorp	Concerning PacifiCorp's Schedule 38 avoided cost proceeding
12/05	04-035-42	UT	Utah Committee for Consumer Services	PacifiCorp	Net power costs in General Rate Case
04/06	05-035-54	UT	Utah Committee for Consumer Services	PacifiCorp	Certification request to expand Blundell Geothermal Power Station. Related to Mid-American Energy Holding's Acquisition of PacifiCorp
05/06	22403-U	GA	Georgia Public Service Commission Staff	Georgia Power and Savannah Electric	March 2006 fuel cost recovery filing
2006	06-35-01	UT	Utah Committee for Consumer Services	PacifiCorp	2006 rate case, net power costs
08/06	U-21453	LA	Louisiana Public Service Commission Staff	Entergy Gulf States	Jurisdictional separation.
11/06	U-25116	LA	Louisiana Public Service Commission Staff	Entergy Louisiana	Fuel adjustment clause filings
01/07	23540-U	GA	Georgia Public Service Commission Staff	Georgia Power	November 2005 fuel cost recovery filing
04/07	07-035-93	UT	Utah Committee for Consumer Services	PacifiCorp	General Rate Case
06/07	24505-U	GA	Georgia Public Service Commission Staff	Georgia Power	2007 Integrated Resource Planning
10/07	U-30334	LA	Louisiana Public Service Commission Staff	Cleco Power	2008 Short-Term RFP
04/08	26794-U (FCR-20)	GA	Georgia Public Service Commission Staff	Georgia Power	Fuel cost recovery filing

Date	Case	Jurisdict	Party	Utility	Subject
2008	6630-CE-299	WI	Wisconsin Industrial Energy Group, Inc.	WEPCO	Certification Proceeding for environmental upgrades at Oak Creek power plant
07/08	ER07-956	FERC	Louisiana Public Service Commission	Entergy	2006 rough production cost equalization compliance filing in the System Agreement case
09/08	6680-CE-180	WI	Wisconsin Industrial Energy Group, Inc.	Wisconsin Power and Light	Certification proceeding concerning Nelson-Dewey coal-fired generating unit
11/08	08-1511-E-GI	WV	West Virginia Energy Users Group	Allegheny Power	Fuel cost recovery filing
12/08	27800-U	GA	Georgia Public Service Commission Staff	Georgia Power	Vogtle 3 and 4 nuclear unit certification proceeding
2008	08-035-35	UT	Utah Committee for Consumer Services	PacifiCorp	Chehalis Combine Cycle Power Plant based on a waiver of the RFP solicitation process certification proceeding
07/09	ER08-1056	FERC	Louisiana Public Service Commission	Entergy	2007 rough production cost equalization compliance filing in the System Agreement case
07/09	U-30975	LA	Louisiana Public Service Commission Staff	SWEPCO and Cleco	Application to acquire the Oxbow Mine to supply Dolet Hills Power Station certification proceeding
09/09	E015/PA-09-526	MN	Large Power Intervenors	Minnesota Power	Request for approval to purchase Square Butte's 500 kV DC transmission line, restructure a coal based power purchase agreement
09/09	09-035-23 Direct	UT	Utah Office of Consumer Services	PacifiCorp	2009 rate case, net power costs
10/09	09A-415E	CO	Public Utilities Commission of Colorado	Black Hills/Colorado	CPCN application to construct two LMS 100 natural gas combustion turbine units
10/09	09-035-23 Surrebuttal	UT	Utah Office of Consumer Services	PacifiCorp	2009 rate case, net power costs
12/09	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	First Semi-Annual Vogtle Construction Monitoring Report

Date	Case	Jurisdict	Party	Utility	Subject
12/09	ER08-1224	FERC	Louisiana Public Service Commission	Entergy	2008 production costs used to develop bandwidth payments
2009	09-2035-01	UT	Utah Office of Consumer Services	PacifiCorp	2008 IRP
01/10	28945-U	GA	Georgia Public Service Commission Staff	Georgia Power	Fuel cost recovery filing
2010	EL09-61	FERC	Louisiana Public Service Commission	Entergy	System Agreement, individual operating company sales
06/10	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Second Semi-Annual Vogtle Construction Monitoring Report
12/10	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Third Semi-Annual Vogtle Construction Monitoring Report
01/11	ER09-1350 Direct	FERC	Louisiana Public Service Commission	Entergy	2008 production costs used to develop bandwidth payments
02/11	ER09-1350 Cross-Answering	FERC	Louisiana Public Service Commission	Entergy	2008 production costs used to develop bandwidth payments
04/11	33302-U (FCR-22)	GA	Georgia Public Service Commission Staff	Georgia Power	Fuel cost recovery filing
06/11	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Fourth Semi-Annual Vogtle Construction Monitoring Report
09/11	U-31892	LA	Louisiana Public Service Commission Staff	Cleco Power	Settlement agreement, CPCN to upgrade Madison 3 coal unit to accommodate biomass fuel
11/11	26550-U	GA	Georgia Public Service Commission Staff	Georgia Power	Reacquisition of wholesale block capacity
11/11	34218-U	GA	Georgia Public Service Commission Staff	Georgia Power	Decertification of two aging coal units, acquire PPA resources, approve IRP update

Date	Case	Jurisdict	Party	Utility	Subject
12/11	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Fifth Semi-Annual Vogtle Construction Monitoring Report
03/12	U-32148	LA	Louisiana Public Service Commission Staff	Entergy	Change of Control Proceeding to move to Midwest ISO
2012	20000-EA-400-11	WY	Wyoming Industrial Energy Consumers	Rocky Mountain Power	Certification of environmental upgrades at Naughton 3
05/12	35277-U (FCR-23)	GA	Georgia Public Service Commission Staff	Georgia Power	Fuel cost recovery filing
05/12	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Sixth Semi-Annual Vogtle Construction Monitoring Report
07/12	2012-00063	KY	Kentucky Industrial Utility Customers, Inc.	Big Rivers	Environmental upgrades in compliance with MATS and CSAPR
09/12	U-32275	LA	Louisiana Public Service Commission Staff	Dixie Electric Member Cooperative	Ten year power supply acquisition certification proceeding
12/12	EL09-61-002 Direct	FERC	Louisiana Public Service Commission	Entergy	Harm calculation, violation of System Agreement
12/12	U-32557	LA	Louisiana Public Service Commission Staff	Entergy	Certification of 28 MW PPA for renewable energy capacity (RAIN waste heat) in accordance with LPSC's Renewable Energy Pilot
12/12	U-29764	LA	Louisiana Public Service Commission Staff	Entergy	Retail proceeding regarding termination of cross-PPAs
12/12	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Seventh Semi-Annual Vogtle Construction Monitoring Report
03/13	EL09-61-002 Cross-Answering	FERC	Louisiana Public Service Commission	Entergy	Harm calculation, violation of System Agreement
04/13	2012-00578	KY	Kentucky Industrial Utility Customers, Inc.	Kentucky Power Company	Mitchell Certificate of Public Convenience and Necessity

Date	Case	Jurisdict	Party	Utility	Subject
05/13	36498-U	GA	Georgia Public Service Commission Staff	Georgia Power	2013 IRP and request to decertify over 2,000 MW of coal-fired capacity
07/13	U-32785	LA	Louisiana Public Service Commission Staff	Entergy	8.5 MW PPA for renewable energy capacity (Agrilectric rice hull) in accordance with LPSC's Renewable Energy Pilot
08/13	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Eighth Semi-Annual Vogtle Construction Monitoring Report
10/13	2013-00199	KY	Kentucky Industrial Utility Customers, Inc.	Big Rivers	Base rate case
05/14	13-035-184	UT	Utah Office of Consumer Services	PacifiCorp	2014 General Rate Case, net power cost
06/14	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Ninth/Tenth Semi-Annual Vogtle Construction Monitoring Report
07/14	20000-446-EA-14	WY	Wyoming Industrial Energy Consumers	PacifiCorp	2014 General Rate Case, net power cost
08/14	2000-447-EA-14	WY	Wyoming Industrial Energy Consumers	PacifiCorp	2014 Energy Cost Adjustment Mechanism application
08/14	14-035-31	UT	Utah Office of Consumer Services	PacifiCorp	2014 Energy Balancing Adjustment application
09/14	ER13-432	FERC	Louisiana Public Service Commission	Entergy	Allocation of Union Pacific Settlement Agreement benefits
10/14	2014-00225	KY	Kentucky Industrial Utility Customers, Inc.	Kentucky Power	Kentucky Power Company's Fuel Adjustment Clause
12/14	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Eleventh Semi-Annual Vogtle Construction Monitoring Report
05/15	14-035-140	UT	Utah Office of Consumer Services	PacifiCorp	Solar and wind capacity contribution avoided cost proceeding.
06/15	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Twelfth Semi-Annual Vogtle Construction Monitoring Report

Date	Case	Jurisdict	Party	Utility	Subject
08/15	15-035-03	UT	Utah Office of Consumer Services	PacifiCorp	2015 Energy Balancing Adjustment application
09/15	14-035-114	UT	Utah Office of Consumer Services	PacifiCorp	Cost and Benefits of PacifiCorp's Net Metering Program
11/15	39638-U	GA	Georgia Public Service Commission Staff	Georgia Power	FCR-24 Fuel Cost Recovery Proceeding
11/15	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Thirteenth Semi-Annual Vogtle Construction Monitoring Report
5/16	40161	GA	Georgia Public Service Commission Staff	Georgia Power	Georgia Power Company's 2016 IRP and Application for Decertification of Plant Mitchell Units 3, 4A, and 4B, Kraft Unit 1 CT, and Intercession City CT
6/16	29849	GA	Georgia Public Service Commission Staff	Georgia Power	Fourteenth Semi-Annual Vogtle Construction Monitoring Report
8/16	16-035-27	UT	Utah Office of Consumer Services	PacifiCorp	Renewable Energy Services Contract between Rocky Mountain Power and Facebook, Inc
8/16	16-035-01	UT	Utah Office of Consumer Services	PacifiCorp	2016 Energy Balancing Adjustment application
9/16	09-035-15	UT	Utah Office of Consumer Services	PacifiCorp	EBA Pilot Evaluation Direct Testimony
11/16	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Fifteenth Semi-Annual Vogtle Construction Monitoring Report
11/16	09-035-15	UT	Utah Office of Consumer Services	PacifiCorp	EBA Pilot Evaluation Rebuttal Testimony
11/16	EL09-61-04	FERC	Louisiana Public Service Commission	Entergy	Violation of System Agreement, Phase III, Harm Calculation, Direct
3/17	EL09-61-04	FERC	Louisiana Public Service Commission	Entergy	Violation of System Agreement, Phase III, Harm Calculation, Rebuttal
6/17	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Sixteenth Semi-Annual Vogtle Construction Monitoring Report

Date	Case	Jurisdict	Party	Utility	Subject
9/17	17-035-39	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision to Repower Wind Facilities, Direct
11/17	17-035-39	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision to Repower Wind Facilities, Surrebuttal
4/18	17-035-39	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision to Repower Wind Facilities, Response
4/18	17-035-39	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision to Repower Wind Facilities, Rebuttal to Response
12/17	17-035-40	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision for New Wind and New Transmission, Direct
1/18	17-035-40	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision for New Wind and New Transmission, Rebuttal
4/18	17-035-40	UT	Utah Office of Consumer Services	PacifiCorp	Approval of Resource Decision for New Wind and New Transmission, Second Rebuttal
6/18	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Eighteenth Semi-Annual Vogtle Construction Monitoring Report
8/18	Cause 45052	IN	Indiana Coal Council	Vectren Energy Delivery of Indiana	Request for Approval of an 850 MW CCGT Plant
9/18	U-34836	LA	Louisiana Public Service Commission Staff	Entergy Louisiana, LLC	Authorization to Participate in a 50 MW Solar PPA
11/18	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Nineteenth Semi-Annual Vogtle Construction Monitoring Report
1/19	U-35019	LA	Louisiana Public Service Commission Staff	Entergy Louisiana	Authorization to Make Available Experimental Renewable Option and Rate Schedule RTO
4/19	42310-U	GA	Georgia Public Service Commission Staff	Georgia Power	Georgia Power's 2019 IRP Proceeding
11/19	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Twenty/Twenty-First Semi-Annual Vogtle Construction Monitoring Report

Date	Case	Jurisdict	Party	Utility	Subject
5/20	43011-U	GA	Georgia Public Service Commission Staff	Georgia Power	Georgia Power Fuel Cost Recovery Application (FCR-25)
6/20	29849-U	GA	Georgia Public Service Commission Staff	Georgia Power	Twenty-Second Semi-Annual Vogtle Construction Monitoring Report

ADDITIONAL JUDICIAL PROCEEDINGS AND OTHER PROJECT INFORMATION

- 1995 – 2000 - Modeled the Singapore Power Electricity System and analyzed the benefits of dispatching a new oil-fired unit within the system, BHP Power
- 1995 – 2000 - Modeled the Australian National Energy Market to develop market based energy price forecasts on behalf of an Independent Power Producer in Australia, BHP Power
- 1995 – 2000 - Analyzed the benefit of purchasing existing gas-fired steam turbine units within the Australian market, BHP Power
- 1995 – 2000 Developed market price forecasts for South Australia as part of the evaluation of a new gas fired combined cycle unit, BHP Power
- 1995 – 2000 - Modeled the Vietnam Electricity System as part of a project to develop Least Cost Expansion plans for Vietnam, EVN State Utility
- 1995 – 2000 - Assisted in the evaluation of Phu My CCGT power plant in Vietnam, BHP Power
- 1995 – 2000 - Assisted in the development of Market Price Forecasts in several regions of the US. These forecasts were used as the basis for stranded cost estimates, which were filed in testimony in a number of jurisdictions across the country.
- 1995 – 2000 - Conducted research regarding ISO Tariffs and Operations for the PJM Power Pool, the California ISO, and the Midwest ISO on behalf of a Japanese Research.
- 1995 – 2000 - Performed research on numerous electric utility issues for 3 Japanese research organizations. This was primarily related to deregulation issues in the US in anticipation of deregulation being introduced in Japan.
- 1995 – 2000 - Critiqued the IRP filings of 5 utilities in South Carolina on behalf of the South Carolina State Energy Office
- 1999 - Helped to analyze the rate structure and develop an electricity price forecast for the Metropolitan Atlanta Rapid Transit Authority (MARTA) in Atlanta, Georgia
- August 2002 – Expert Report, Civil Action No. 1:00-cv-1262 in the United Stated District Court for the Middle District of North Carolina, United States v. Duke Energy Corporation, Department of Justice

- 2002 - Worked on behalf of the Utah Committee of Consumer Services to provide guidance and assist in the analysis of PacifiCorp's 2002 Integrated Resource Plan.
- July 2003 - Worked on behalf of the Oregon Public Utility Commission to Audit PacifiCorp's Net Power Costs per a Settlement Agreement accepted by the Public Utility Commission of Oregon in its Order No. 01-787. Audit report in Docket No. UE-116 filed July 2003.
- 2003 - Regulatory support to the Utah Committee of Consumer Services regarding PacifiCorp's 2003 Utah General Rate Case Docket # 03-2035-02.
- 2004 – Assistance to the Utah Committee of Consumer Services to analyze a series of power purchase agreements and special contracts between PacifiCorp and several of its industrial customers.
- 2005 - Worked on behalf of the Utah Committee of Consumer Services to help analyze PacifiCorp's restructuring proposals.
- 2005 - Assisted the Utah Committee of Consumer Services by evaluating PacifiCorp's 2005 IRP and assisted in writing comments that were filed with the Commission.
- 2007 - Assisted the Utah Committee of Consumer Services to evaluate PacifiCorp's 2007 IRP.
- 2007 - Conducted an investigation of the Southern Company interchange accounting and fuel accounting practices on behalf of the Georgia Public Service Commission Staff (Docket 21162-U).
- 2008 - Assisted the Louisiana Public Service Commission Staff with the review and evaluation of Cleco Power's 2008 Short Term RFP and its 2010 Long-Term RFP.
- 2008 - Assisted the Utah Committee of Consumer Services by participating in a collaborative process to develop an avoided cost tariff for large QFs.
- 2008 - Assisted the Louisiana Public Service Commission Staff with a rulemaking for the opportunity to implement a Renewable Portfolio Standard in Louisiana. (Docket No. R-28271 Sub-Docket B)
- April 2011 – Initial Expert Report, Civil Action No. 2:10-cv-13101-BAF-RSW, on behalf of the Department of Justice in US District Court, United States v.Detroit Edison
- June 2011 – Rebuttal Expert Report, Civil Action No. 2:10-cv-13101-BAF-RSW, on behalf of the Department of Justice in US District Court, United States Detroit Edison
- 2011 - Assisted the Georgia Public Service Commission Staff to investigate the acquisition of additional coal and combustion turbine capacity currently wholesale capacity (Docket 26550).
- 2012 - Assisted the Louisiana Public Service Commission Staff with a rulemaking to design Integrated Resource Planning ("IRP") rules. (Docket No. R-30021)

- December 2013 – Expert Report, Civil action no. 4:11-cv-00077-RWS, on behalf of the Department of Justice in US District Court, United States v. Ameren Missouri.

PUBLICATIONS AND PRESENTATIONS

Co-authored "Review of EPA's Section 111(d) CO_2 Emission Rate Goals for the State of Montana, on behalf of the Montana Large Customer Group, October 2014.

Authored "Singapore's Developing Power Market", which appeared in the July/August 1999 edition of Power Value Magazine

Co-authored "The New Energy Services Industry – Part 1", which appeared in the January/February 1999 edition of Power Value Magazine.

Co-authored and Presented "Evaluation of a Large Number of Demand-Side Measures in the IRP Process: Florida Power Corporation's Experience", Presented at the 3rd International Energy and DSM Conference, Vancouver British Columbia, November 1994

Co-authored "Impact of DSM Program on Delmarva's Integrated Resource Plan", Published in the 4th International Energy and DSM Conference Proceedings, held in Berlin, Germany, 1995

Presentation – Law Seminars International, Electric Utility Rate Cases, Case Study of the Louisiana Public Service Commission's Quick Start Energy Efficiency Program, March 2015.